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Effect of polyacrylic acid on phase state of lipids and diffusion in lipid-water system

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Abstract

Lipid vesicles interacting with polyanions are promising for controlled drug delivery. However, different aspects of the interaction of these polymers with lipids are far from complete understanding. In this work we studied the influence of polyacrylic acid (PAA) with small concentrations (1-4 mol%) on the change of the phase state, lateral diffusion of these lipids in lamellar phase and transmembrane water diffusion in macroscopically oriented bilayers of lipid-water systems formed by dimiristoylphosphatidylcholine (DMPC) and dioleoylphosphatidylcholine. Measurements were performed by 31P nuclear magnetic resonance (NMR) spectroscopy and the 1H NMR technique with a pulsed field gradient. It was found that the presence of PAA does not change the lamellar structure of the system. However, a part of bilayers changes their originally flat geometry and forms vesicles with a higher surface curvature. Macroscopic orientation of bilayers disappeared. For DMPC the presence of PAA leads to a shift of the gel-to-liquid crystalline phase-transition temperature to higher temperatures. An increase of PAA concentration leads to a monotonous decrease in the lateral diffusion coefficient of lipids that is caused, probably, by the ordering of lipids in bilayers. The transbilayer diffusion coefficient of water increases in the presence of PAA, but it depends slightly on the PAA concentration. An increase of pH leads to a change of the lipid lateral and transbilayer diffusion coefficients to the values typical for a pure bilayer.

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